

Small Hydropower – Today and Tomorrow

Case Study of Nepal

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Small Hydropower – Definitions

Micro-hydro

Mini-hydro

Small-hydro

Motive power (milling)

Pico-hydro

Electrification

Isolated (Mini-grid)

Grid-connect

Experiences tend to be country specific

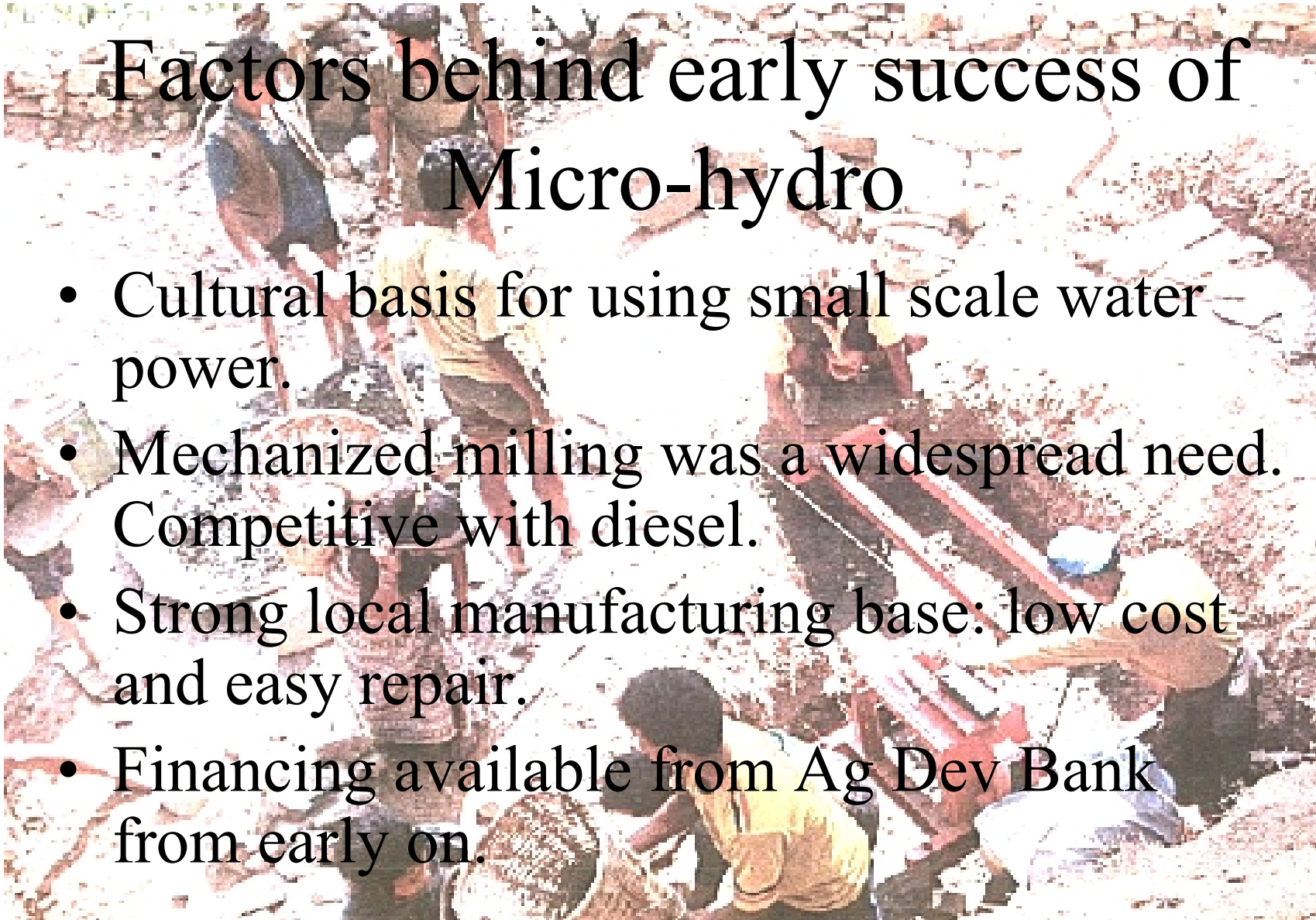


Nepal – Small Hydro Experience

- Traditional use of water mills ‘ghatta’ and irrigation canals.
- Diesel engines for agricultural milling made their way into the middle hills in 1970s.
- NGOs and local workshops developed low cost cross-flow turbines to substitute for diesel mills. Ag Dev Bank provided loans for micro-hydropower.
- Starting 1970s, the national utility built mini hydro projects as per the government’s commitment to electrify remote district HQ.
- 1984 – government deregulates private electricity < 100 kW, tariffs to be negotiated. Government provided subsidies to electricity producers.
- 1998 – NEA agrees to buy all energy produced from projects smaller than 5 MW for the grid at a standard offer of around 5cents/kWh.

Current Status of Installations

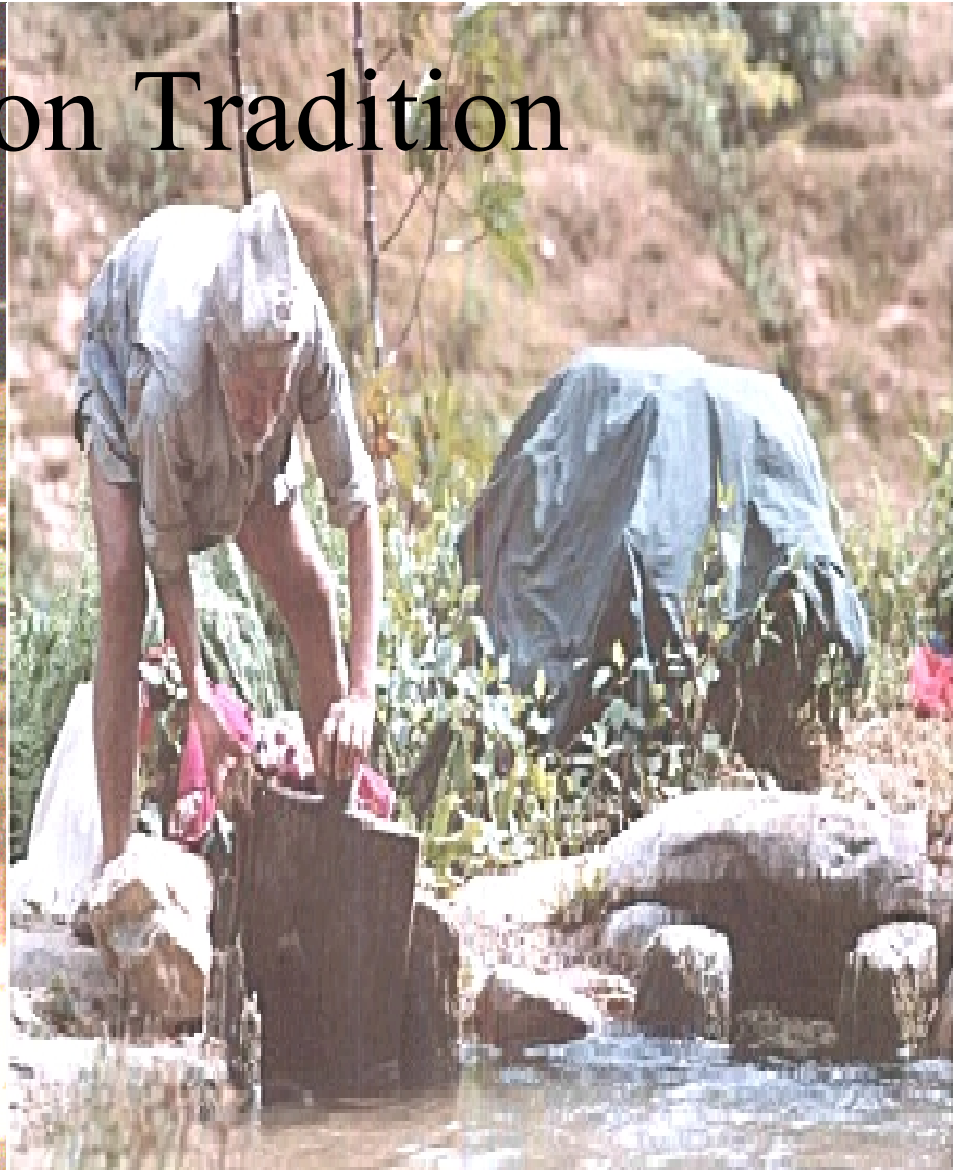
| Type | Total numbers | Installed capacity | Households served |
|---------------------------------|----------------------|---------------------------|--------------------------|
| Traditional ‘ghatta’ | 25,000 | 12,000 kW | 500,000 |
| Improved ‘ghatta’ | 650 | 1,200 kW | 50,000 |
| Micro-hydro milling | 900 | 5,000 kW | 270,000 |
| Peltric Sets | 600 | 600 kW | <i>6,000</i> |
| Micro-hydro electricity | 300 | 4,200 kW | <i>42,000</i> |
| Mini-hydro (NEA) | 35 | 8,000 kW | <i>34,000</i> |
| Small hydro- on the grid | 12 | 40,000 kW | <i>69,000</i> |



Factors behind early success of Micro-hydro

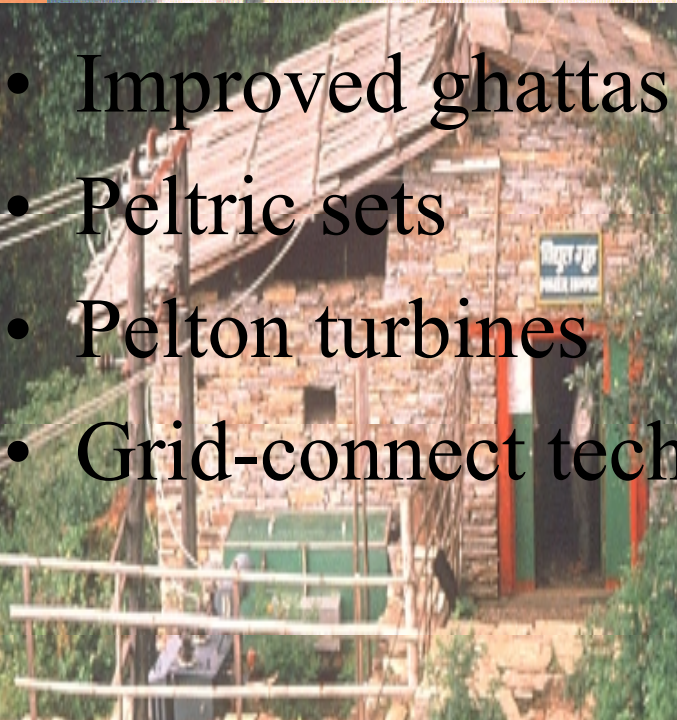
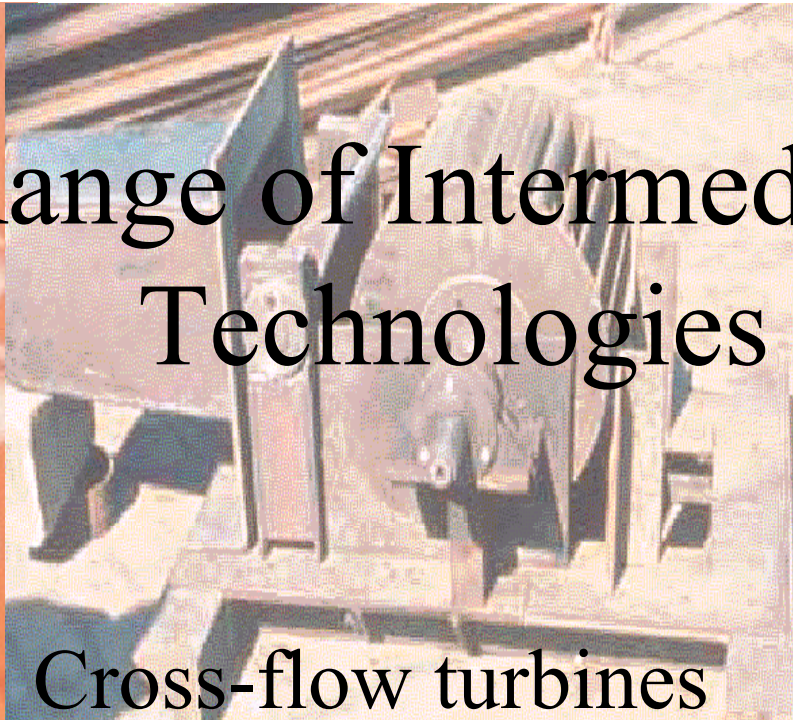
- Cultural basis for using small scale water power.
- Mechanized milling was a widespread need. Competitive with diesel.
- Strong local manufacturing base: low cost and easy repair.
- Financing available from Ag Dev Bank from early on.

Building on Tradition



Range of Intermed Technologies

- Cross-flow turbines
- Improved ghattas
- Peltric sets
- Pelton turbines
- Grid-connect tech



Subsidies

- Mills needed no subsidies – charging 5% of value of milled product generates sufficient revenue.
- Improved ‘ghatta’ need NGO support for promotion in remote areas but not for hardware.
- Electric projects need subsidies to arrive at similar prices as urban consumers (9-12 cents/kWh).
- Subsidies justified because micro-hydro systems can also provide employment and community benefits to those who can not afford a home connection.
- Subsidies give the promoter a seat at the table to control quality and put in regulations and can be effective in scaling up.

Problems with the sector

- Most projects are working, but limited scaling up.
- Milling saturated in more accessible areas but very sparse in remote districts. Market had reached its limit.
- National utility built isolated mini and small hydro - working at low capacity, over staffing, unable to cover O&M from revenue. Not responsive to needs of users.
- Technical support to projects in remote areas inadequate.
- No standardization of equipment. Subsidies not able to leverage quality control. Large % of subsidies appropriated by manufacturers.
- Many projects technically functioning but financially failing.
 - Low load factor.
 - Oversupply of turbine mills.
 - Poor management.
 - Inability to increase tariff in community projects to cover inflation.

New Modalities for Promotion

- Community-based (REDP/UNDP, NGOs)
 - Participatory (including role of all users and women),
 - Equitable (access extended to whole community),
 - Development of social capital, MHP and entry point for holistic development,
 - Around 20 projects, 400 kW/yr.

New Modalities....

Entrepreneur-led model.

- DANIDA support,
- Area Support Centers, strong emphasis on productive end uses,
- National subsidy plan (\$1,000/kW produced, tariff reduced from 18 cents – 12 cents/kWh),
- Efficient; lower soft support costs,
- Clear ownership, financial sustainability in the long run,
- Especially suitable for commercial areas,
- Around 500 kW/yr projected.

New modalities....

- Grid-connect IPP projects
 - Standard PPA offer by national utility (4.5 cents/kWh wet season and 6.4 cents/kWh in dry season) for projects up to 5 MW.
 - 20 projects undergoing feasibility studies, 3 with signed PPAs, 2 under construction.
 - Hypothesis: this will accelerate grid connection to new consumers.

Challenges Ahead – Scaling up

- Continuity of government subsidy for micro-hydro projects.
- Productive End-Uses for isolated projects
- Standardization of equipment. Technology transfer. Higher efficiency for larger projects.
- Continuity in utility policy for grid-connect IPP projects and ability of national utility to purchase produced energy.
- Creating financing mechanisms for the larger projects.

MHP Mini-grid End-Uses Ladder

| Areas | I | II | III | IV | V |
|-------------------------------------|---|--|--|---|---|
| Road access | After 20 yrs | Within 20 yrs | Not for 10 yrs | After 20 yrs | Ag. roads exist |
| HEATING COOKING | | | | Hot showers, Jacuzzis Water heating, cooking. Room heating. | |
| ENTERPRISE | Telecommunication. | Hand-made paper, herb distillation, drying fruits, mushrooms etc. Rural telecom. | Battery charging. Noodle making. Bakeries. Sawmill, metal workshop. Rural telecom. | Battery charging. Noodle making. Large Bakeries. Sawmill, metal workshop. Rural telecom. | Pump irrigation. Cold storage. Cheese, jams. Battery charging. Noodle making. Bakeries. Sawmill, metal workshop. Rural telecom. |
| LIGHTING RADIO/TV | Can't afford | Handicrafts Shops, commerce Lights, TV, radio | Video parlor, Photo studio Handicrafts Shops, commerce Lights, TV, radio | Video parlor, Photo studio Handicrafts Shops, commerce Lights, TV, radio | Video parlor, Photo studio Handicrafts Shops, commerce Lights, TV, radio |
| MILLING | yes | yes | yes | Yes | extensive |
| ↑ Likely MHP End-uses | <i>Remote; subsistence economy; low ag. production.</i> | <i>Remote; natural resource-based export; low ag. production.</i> | <i>Relatively remote; low ag. production; ext.. income from overseas, Govt/NGO salaries.</i> | <i>Remote; low ag. production; conservation zones, income from tourism,.</i> | <i>Non-remote areas, surplus and niche agricultural production</i> |

Lessons Learned

- Milling is a natural first step. Big social benefits. Electricity can bring about end-use development if other infrastructure is already in place, roads and telecom.
- Government/large utilities are not suitable to build and operate small hydro.
- Subsidies can be suitable if they are available long term. But must be well designed and leverage quality control. Irregular subsidies are worse than no subsidies.

Lessons Learned...

- Community projects need a substantial amount of support but end result is more than just the project.
- Local manufacturing base is important - simple technology and low cost for small projects.
Efficiency is critical and import is a good option for larger projects.
- Supportive government policy and development bank financing is crucial.